SOLAR/2014-79/03

Monthly Performance Report

BLAKEDALE PROFESSIONAL CENTER

MARCH 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
BLAKEDALE PROFESSIONAL CENTER
MARCH 1979

I. SYSTEM DESCRIPTION

The Blakedale Professional Center solar energy system is designed to provide 85 percent of the space heating load and 100 percent of the domestic hot water load for a 4,400 square foot office suit in Greenwood, South Carolina. Solar energy is collected by 53 flat-plate collectors, which are manufactured by PPG Industries. The collectors, having a gross area of 964 square feet, are arranged in three banks and are mounted on the roof. Each collector array faces south at an angle of 45 degrees from the horizontal. The heat transfer medium is 99 percent water and one percent corrosion inhibitors. Solar Energy is stored in a 5,000-gallon tank that is buried under the parking lot. The tank is insulated with four inches of sprayed-on polyurethane which is covered with a waterproof coating. When solar energy is inadequate, auxiliary space heating is provided by a 10-ton heat pump and a 36-kilowatt electric resistance heater. Auxiliary hot water heating is provided by a 40-gallon electric heater. Freeze protection is provided by a drain-down system.

The system, shown schematically in Figure 1, has four modes of operation:

Mode 1 - Collector-to-Storage: This mode is entered when the temperature of the collector is 19°F higher than the temperature of water near the bottom of the water thermal storage. Pump P1 circulates water through the collectors to transfer solar energy to the water thermal storage. This mode terminates when the temperature differential is less than 6°F, or the temperature of water in the collector is less than 37°F.

Mode 2 - Storage-to-Office Area (Solar): This mode is entered when heat is required in the office area and the storage temperature is greater than 100°F. Pump P2 circulates water through the water thermal storage

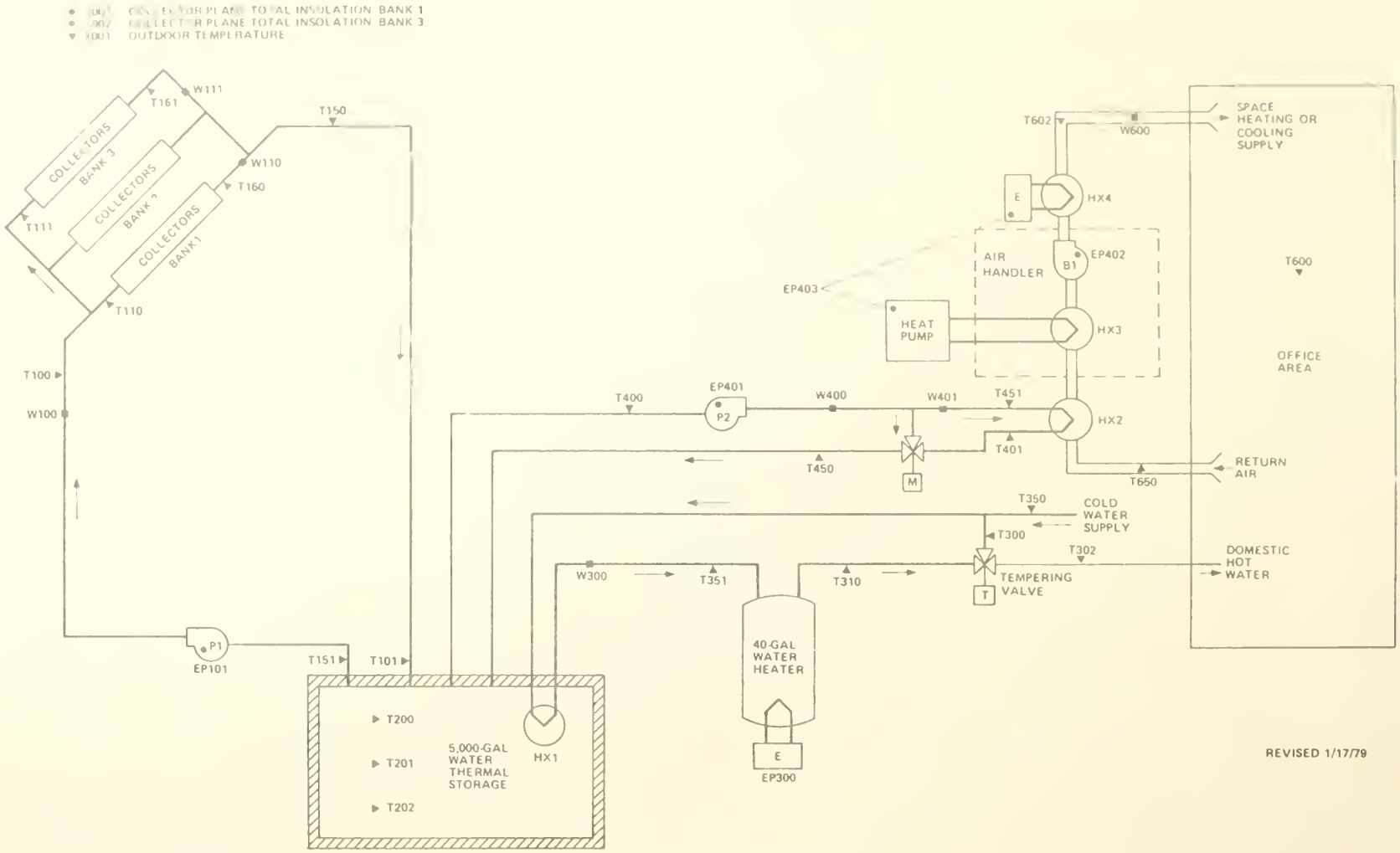

Figure 1. BLAKEDALE PROFESSIONAL CENTER SOLAR ENERGY SYSTEM SCHEMATIC

to heat exchanger HX2 in the air-handling unit. This mode terminates when the temperature of the air supplied to the building is greater than 120°F, when the motorized valve bypasses this heat exchanger; or the thermostat demand for heat is satisfied.

Mode 3 - Storage-to-Office Area (Auxiliary): Although this mode is not a solar mode of operation, it is entered concurrently with Mode 2 when heat is required in the office and the office return air temperature is less than 65°F. A 10-ton heat pump is energized to provide thermal energy to heat exchanger HX3. When the outside air temperature is less than 40°F, two 18-kilowatt electric resistance heaters are energized in stages to provide auxiliary energy to heat exchanger HX4. This mode terminates when the office return air temperature is greater than 68°F, or the thermostat demand for heat is satisfied.

Mode 4 - Domestic Hot Water Preheating: This mode is entered when there is a requirement for hot water. As hot water is drawn, cold water from the service mains passes through heat exchanger HX1 in the water thermal storage. This mode terminates when the requirement for hot water is satisfied.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

During March, 33 percent of the 9.77 million Btu system load for space heating was provided by solar energy. However, the resident contractor

has modified the control system for the space heating subsystem so that pump P2 operates continuously. This excessive operation required an additional 0.72 million Btu of electrical energy, and resulted in an additional transport loss of 0.82 million Btu of solar energy. The additional operating energy reduces the electrical energy savings associated with the solar contribution to the space heating load. The electrical savings of the space heating system then equal the collector operating energy, resulting in essentially zero electric energy savings.

In addition, pump P1 in the energy collection and storage subsystem either started operating prematurely or required manual intervention to initiate collection; and, to a much smaller extent, stopped operating late. This excessive operation resulted in the removal of 0.91 million Btu of solar energy from thermal storage. These losses were composed of 0.67 million Btu from transportation and 0.24 million Btu from the collectors.

The energy collection and storage subsystem was operational until March 25 and after March 29. Cumulative evaporation losses from the system reduced the amount of water in thermal storage to a level that prevented pump P1 from circulating the water that removes solar energy from the collectors on March 25. Thermal storage water was replenished on March 30, enabling collection to resume.

The space heating subsystem was operational during the entire month. However, after March 24, the aforementioned evaporation losses prevented pump P2 from circulating the water that delivers solar energy to heat exchanger HX2.

The domestic hot water preheating subsystem was not operational during the month.

B. Weather

During March, the temperature in Greenwood, South Carolina was warmer than normal, as evidenced by an average ambient (outside) temperature of 59°F when compared to the long-term value of 50°F. This long-term value was obtained from the climatological data for the nearby city Greenville, SC. In addition, there was more cloud cover than normal, as evidenced by an average daily insolation of 1,503 Btu/ft^2 when compared to the long-term value of 1,661 Btu/ft^2. This long-term value was obtained from an algorithm that projects the mean daily horizontal insolation onto the plane of the collectors.

C. Thermal Performance

Collector - During March, 44.44 million Btu of solar energy were incident upon the collector array, and 30.47 million Btu were incident during the operation of this subsystem. From this, a gross amount of 9.88 million Btu was collected.

Due to the abnormal operation of pump P1, the temperature of water entering the collectors was greater than the temperature of water that was leaving for short periods of time. As a result, 0.24 million Btu of solar energy was transferred from thermal storage to the collectors, and subsequently dissipated to the environment. This process was accelerated when the subsystem cycled frequently, as during periods of marginal or intermittent insolation, making the net daily value for collected solar energy negative on two days. Consequently, the amount of collected solar energy and the collector array efficiency was smaller than normal. The net amount of collected solar energy was 9.64 million Btu, and the collector array efficiency was 22 percent, with an operational efficiency of 32 percent. A total of 0.35 million Btu of electrical energy was required to operate the subsystem.

Pump P1 did not always start operating automatically upon the availability of solar energy at the collectors, although it always stopped automatically. When the resident contractor observed the failed condition, he manually started the pump.

Storage - From the 9.88 million Btu of solar energy collected, 9.20 million Btu were delivered to thermal storage and 0.68 million Btu were lost during transport. However, a net amount of 8.29 million Btu was delivered to thermal storage. The difference between the gross and net values represents the amount of energy that was removed from storage due to the excessive operation of pump P1. These losses were composed of 0.67 million Btu from transportation and 0.24 million Btu from the collectors. In addition, the net daily value for energy to storage was negative on three days. Consequently, the amount of energy to storage was smaller than nominal.

From storage, 4.15 million Btu were removed for the space heating subsystem, essentially zero Btu were removed for the domestic hot water preheating subsystem, and an estimated 3.53 million Btu were lost to the environment, resulting in an estimated storage efficiency of 57 percent. The average daily storage temperature was 108°F. Since the amount of water in thermal storage was not constant, the values for change in stored energy, storage efficiency, and storage losses are estimates. With the existing instrumentation, it is not possible to ascertain the amount of energy that was lost from evaporation.

Domestic Hot Water Preheating - There was essentially no requirement for hot water, as evidenced by the fact that the resident contractor did not operate the auxiliary water heater. An insignificant amount of solar energy was removed from thermal storage whenever the hot water taps were opened. This load is neglected, and assumed to be zero.

Space Heating - From the 4.15 million Btu of solar energy delivered to this subsystem, 3.19 million Btu were delivered to heat exchanger HX2, and 0.96 million Btu were lost during transport. From the 2.43 million Btu of electrical energy that were consumed by the heat pump and resistance heater, 1.72 million Btu of thermal energy were delivered to heat exchanger HX3. In addition, the heat pump delivered 4.86 million Btu of environmental energy to this heat exchanger. A total of 1.62 million Btu of electrical energy was required to operate the subsystem in order to maintain an average inside daily building temperature of 72°F. Therefore, 33 percent of the 9.77 million Btu subsystem load was provided by solar energy, resulting in an electrical energy savings of 0.35 million Btu.

The resident contractor modified the control system for this subsystem on March 5, whereby he operated pump P2 continuously. The operation forced the control system to circulate solar energy from storage to the load distribution valve regardless of demand. During periods of time in which solar energy was not delivered to heat exchanger HX2, the operation of this pump required 0.72 million Btu of electrical energy, and resulted in a transport loss of 0.82 million Btu of solar energy.

D. Observations

During March, an estimated 5.12 million Btu of solar energy was lost to the environment from the energy collection and storage subsystem. These losses were composed of 0.24 million Btu from the collectors due to the excessive operation of this subsystem, 1.35 million Btu from transportation of the heat transfer medium, and an estimated 3.53 million Btu from storage. Although the latter value is large, it is not possible to differentiate between normal storage losses and evaporation losses.

For the space heating subsystem, 0.96 million Btu of solar energy were lost to the environment. This loss occurred during transfer of solar energy from thermal storage to this subsystem. However, 0.82 million Btu of the 0.96 million Btu were lost due to the excessive operation of pump P2. In addition, 0.72 million Btu of electrical energy were required to support this excessive operation, and resulted in a corresponding decrease in electrical energy savings.

E. Energy Savings

During March, essentially zero Btu of electrical energy savings were realized from the operation of this solar energy heating system. These savings were based on the energy requirements of a heat pump whose fraction of the load is a function of both ambient (outside) and building (inside) temperatures and whose coefficient of performance is a function of the ambient temperature. These savings are near zero primarily because of the additional electrical energy required for the excessive operation of pump P2 and the additional solar energy lost from the transport of the heat transfer medium.

III. ACTION STATUS

The resident contractor has added water to thermal storage, thereby permitting the system to return to operational status. In addition, the contractor will repair the controller for the energy collection and storage subsystem to insure automatic operation upon the availability of solar energy at the collectors.

Although the contractor is aware of the additional energy required for the excessive operation of pump P2 in the space heating subsystem, he does not plan to change the procedure for the duration of the current heating season.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

SITE/SYSTEM DESCRIPTION:
THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 4400 SQ.FT. OFFICE SUITE. THIS IS ACCOMPLISHED BY CIRCULATING WATER THROUGH 53 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO A 5000 GAL. UNDERGROUND TANK. THE DOMESTIC HOT WATER SUBSYSTEM IS AUGMENTED BY A 4.5 KW WATER HEATER WHEREAS THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 36 KW DUCT HEATER AND A 10 TON HEAT PUMP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	44.443	MILLION BTU
	46586	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	9.643	MILLION BTU
	10107	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	59	DEGREES F
AVERAGE BUILDING TEMPERATURE	72	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.07	
ECSS OPERATING ENERGY	0.350	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	1.973	MILLION BTU
TOTAL ENERGY CONSUMED	14.049	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.000	9.772	N.A.	9.772 MILLION BTU
SOLAR FRACTION	0	33	N.A.	33 PERCENT
SOLAR ENERGY USED	0.000	3.193	N.A.	3.193 MILLION BTU
OPERATING ENERGY	N.A.	1.624	N.A.	1.973 MILLION BTU
AUX. THERMAL ENERGY	0.000	1.722	N.A.	1.722 MILLION BTU
AUX. ELECTRIC FUEL	0.000	2.433	N.A.	2.433 MILLION BTU
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
ELECTRICAL SAVINGS	0.000	0.350	N.A.	0.001 MILLION BTU
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.666

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SCLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

SITE/SYSTEM DESCRIPTION:
THE PURPOSE OF THIS INSTALLATION IS TO PROVIDE SPACE HEATING AND DOMESTIC HOT WATER PREHEATING FOR A 4400 SQ.FT. OFFICE SUITE. THIS IS ACCOMPLISHED BY CIRCULATING WATER THROUGH 53 FLAT PLATE COLLECTORS TO TRANSFER SOLAR ENERGY TO A 5000 GAL. UNDERGROUND TANK. THE DOMESTIC HOT WATER SUBSYSTEM IS AUGMENTED BY A 4.5 KW WATER HEATER WHEREAS THE SPACE HEATING SUBSYSTEM IS AUGMENTED BY A 36 KW DUCT HEATER AND A 10 TON HEAT PUMP.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	46.887	GIGA JOULES
	529028	KJ/SQ.M.
COLLECTED SOLAR ENERGY	10.173	GIGA JOULES
	114780	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	15	DEGREES C
AVERAGE BUILDING TEMPERATURE	22	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.07	
ECSS OPERATING ENERGY	0.369	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	2.082	GIGA JOULES
TOTAL ENERGY CONSUMED	14.822	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.000	10.310	N.A.	10.310 GIGA JOULES
SOLAR FRACTION	0	33	N.A.	33 PERCENT
SOLAR ENERGY USED	0.000	3.369	N.A.	3.369 GIGA JOULES
OPERATING ENERGY	N.A.	1.713	N.A.	2.082 GIGA JOULES
AUX. THERMAL ENG	0.000	1.817	N.A.	1.817 GIGA JOULES
AUX. ELECTRIC FUEL	0.000	2.567	N.A.	2.567 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
ELECTRICAL SAVINGS	0.000	0.370	N.A.	0.001 GIGA JOULES
FOSSIL SAVINGS	N.A.	N.A.	N.A.	N.A. GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.666

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	0.946	54	0.000	N	0.010	N	0.000
2	1.795	60	0.000	O	0.016	O	0.000
3	0.390	60	0.000	T	0.006	T	0.000
4	0.235	65	0.000		0.000		0.000
5	1.678	66	0.018	A	0.017	A	0.011
6	1.690	55	0.221	P	0.014	P	0.131
7	1.739	56	0.204	P	0.012	P	0.117
8	1.470	55	0.243	L	0.015	L	0.165
9	1.813	54	0.163	I	0.016	I	0.090
10	1.033	56	0.124	C	0.009	C	0.120
11	2.153	48	0.002	A	0.010	A	0.001
12	2.228	55	0.139	B	0.016	B	0.062
13	1.703	60	0.205	L	0.016	L	0.121
14	1.250	60	0.268	E	0.010	E	0.215
15	2.073	54	0.179		0.014		0.086
16	1.706	48	0.252		0.012		0.147
17	1.969	55	0.018		0.017		0.009
18	1.917	64	0.000		0.017		0.000
19	1.787	68	0.237		0.016		0.133
20	1.618	72	0.260		0.015		0.160
21	0.924	66	0.207		0.009		0.224
22	0.630	63	0.203		0.009		0.323
23	0.170	61	0.205		0.001		1.211
24	0.574	52	0.044		0.006		0.076
25	0.948	41	0.000		0.000		0.000
26	2.090	47	0.000		0.006		0.000
27	1.562	60	0.000		0.008		0.000
28	1.925	65	0.000		0.009		0.000
29	1.533	69	0.000		0.009		0.000
30	1.688	69	0.000		0.018		0.000
31	1.208	70	0.000		0.018		0.000
SUM	44.443	-	3.193	N.A.	0.350	N.A.	-
AVG	1.434	59	0.103	N.A.	0.011	N.A.	0.072
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: BLAKEDALE PROF. CENTER GREENWOOD, S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	0.946	0.812	0.241	56	0.254
2	1.795	1.672	0.643	71	0.358
3	0.390	0.184	-0.006	64	-0.016
4	0.235	0.000	0.000	68	0.000
5	1.678	1.582	0.567	73	0.338
6	1.690	1.591	0.480	61	0.284
7	1.739	1.453	0.597	68	0.343
8	1.470	1.309	0.376	61	0.256
9	1.813	1.655	0.593	*	0.327
10	1.033	0.658	0.100	64	0.097
11	2.153	1.054	0.305	54	0.141
12	2.228	1.961	0.657	68	0.295
13	1.703	1.580	0.495	*	0.291
14	1.250	1.094	0.309	64	0.247
15	2.073	1.705	0.535	67	0.258
16	1.706	1.219	0.436	56	0.256
17	1.969	1.812	0.644	70	0.327
18	1.917	1.784	0.493	77	0.257
19	1.787	1.660	0.541	80	0.303
20	1.618	1.494	0.438	85	0.271
21	0.924	0.796	0.234	72	0.254
22	0.630	0.446	0.043	68	0.069
23	0.170	0.030	-0.009	63	-0.052
24	0.574	0.237	0.047	52	0.083
25	0.948	0.000	0.000	47	0.000
26	2.090	0.000	0.000	57	0.000
27	1.562	0.000	0.000	73	0.000
28	1.925	0.000	0.000	76	0.000
29	1.533	0.000	0.000	78	0.000
30	1.688	1.572	0.644	79	0.381
31	1.208	1.109	0.240	77	0.199
SUM	44.443	30.469	9.643	-	-
AVG	1.434	0.983	0.311	67	0.217
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.200	0.000	0.123	93	0.615
2	0.517	0.000	0.447	100	0.864
3	-0.067	0.000	-0.109	105	1.626
4	0.000	0.000	-0.046	103	1.000
5	0.500	0.054	0.242	105	0.592
6	0.439	0.259	0.030	107	0.660
7	0.505	0.261	0.141	110	0.797
8	0.349	0.286	-0.103	110	0.525
9	0.497	0.211	0.215	112	0.856
10	0.062	0.173	-0.242	112	-1.109
11	0.263	0.063	0.049	109	0.424
12	0.604	0.188	0.185	112	0.617
13	0.408	0.262	0.065	115	0.801
14	0.304	0.306	-0.182	113	0.409
15	0.508	0.231	0.128	113	0.706
16	0.394	0.299	-0.065	113	0.593
17	0.612	0.076	0.366	117	0.723
18	0.460	0.072	0.179	124	0.545
19	0.500	0.268	0.043	126	0.622
20	0.399	0.314	-0.094	126	0.551
21	0.187	0.270	-0.203	122	0.356
22	0.020	0.242	-0.342	116	-5.075
23	-0.028	0.249	-0.402	107	5.570
24	-0.081	0.063	-0.196	100	1.650
25	0.000	0.000	-0.062	97	1.000
26	0.000	0.000	-0.052	96	1.000
27	0.000	0.000	-0.017	95	1.000
28	0.000	0.000	-0.044	94	1.000
29	0.000	0.000	-0.033	93	1.000
30	0.545	0.000	0.450	97	0.825
31	0.193	0.000	0.144	105	0.749
SUM	8.288	4.146	0.613	-	-
AVG	0.267	0.134	0.020	108	0.574
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.000	0	0.000	N	0.000	0.000	N	0.000	N	64	64	0
2	0.000	0	0.000	O	0.000	0.000	O	0.000	O	64	64	0
3	0.000	0	0.000	T	0.000	0.000	T	0.000	T	64	64	0
4	0.000	0	0.000		0.000	0.000		0.000		64	64	0
5	0.000	0	0.000	A	0.000	0.000	A	0.000	A	64	64	0
6	0.000	0	0.000	P	0.000	0.000	P	0.000	P	64	64	0
7	0.000	0	0.000	P	0.000	0.000	P	0.000	P	64	64	0
8	0.000	0	0.000	L	0.000	0.000	L	0.000	L	64	64	0
9	0.000	0	0.000	I	0.000	0.000	I	0.000	I	64	64	0
10	0.000	0	0.000	C	0.000	0.000	C	0.000	C	64	64	0
11	0.000	0	0.000	A	0.000	0.000	A	0.000	A	64	64	0
12	0.000	0	0.000	B	0.000	0.000	B	0.000	B	64	64	0
13	0.000	0	0.000	L	0.000	0.000	L	0.000	L	64	64	0
14	0.000	0	0.000	E	0.000	0.000	E	0.000	E	64	64	0
15	0.000	0	0.000		0.000	0.000		0.000		64	64	0
16	0.000	0	0.000		0.000	0.000		0.000		64	64	0
17	0.000	0	0.000		0.000	0.000		0.000		64	64	0
18	0.000	0	0.000		0.000	0.000		0.000		64	64	0
19	0.000	0	0.000		0.000	0.000		0.000		64	64	0
20	0.000	0	0.000		0.000	0.000		0.000		64	64	0
21	0.000	0	0.000		0.000	0.000		0.000		64	64	0
22	0.000	0	0.000		0.000	0.000		0.000		64	64	0
23	0.000	0	0.000		0.000	0.000		0.000		64	64	0
24	0.000	0	0.000		0.000	0.000		0.000		64	64	0
25	0.000	0	0.000		0.000	0.000		0.000		64	64	0
26	0.000	0	0.000		0.000	0.000		0.000		64	64	0
27	0.000	0	0.000		0.000	0.000		0.000		64	64	0
28	0.000	0	0.000		0.000	0.000		0.000		64	64	0
29	0.000	0	0.000		0.000	0.000		0.000		64	64	0
30	0.000	0	0.000		0.000	0.000		0.000		64	64	0
31	0.000	0	0.000		0.000	0.000		0.000		64	64	0
SUM	0.000	-	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	-	-	0
AVG	0.000	0	0.000	N.A.	0.000	0.000	N.A.	0.000	N.A.	64	64	0
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C. SOLAR/2014-79/03
REPORT PERIOD: MARCH,1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.381	0	0.000	0.032	0.098	0.140	N	-0.015	N	71	54
2	0.357	0	0.000	0.026	0.092	0.131	O	-0.007	O	72	60
3	0.179	0	0.000	0.014	0.046	0.066	T	-0.009	T	70	60
4	0.042	0	0.000	0.003	0.011	0.016		-0.003		70	65
5	0.116	16	0.018	0.033	0.024	0.034	A	-0.022	A	74	66
6	0.437	51	0.221	0.076	0.055	0.079	P	0.024	P	72	55
7	0.554	37	0.204	0.083	0.097	0.136	P	0.031	P	72	56
8	0.350	69	0.243	0.068	0.029	0.041	L	0.032	L	72	55
9	0.510	32	0.163	0.079	0.097	0.134	I	0.034	I	71	54
10	0.302	41	0.124	0.060	0.043	0.062	C	0.000	C	69	56
11	0.212	1	0.002	0.054	0.052	0.074	A	-0.031	A	66	48
12	0.758	18	0.139	0.094	0.156	0.220	B	0.067	B	72	55
13	0.423	49	0.205	0.070	0.053	0.076	L	0.027	L	74	60
14	0.268	100	0.268	0.061	0.000	0.000	E	0.044	E	75	60
15	0.489	37	0.179	0.082	0.077	0.109		0.038		73	54
16	0.612	41	0.252	0.092	0.093	0.133		0.071		71	48
17	0.235	7	0.018	0.055	0.057	0.081		-0.014		68	55
18	0.093	0	0.000	0.044	0.024	0.033		-0.038		70	64
19	0.256	93	0.237	0.055	0.008	0.012		0.034		76	68
20	0.260	100	0.260	0.056	0.000	0.000		0.044		77	72
21	0.207	100	0.207	0.052	0.000	0.000		0.029		76	66
22	0.203	100	0.203	0.052	0.000	0.000		0.028		76	63
23	0.205	100	0.205	0.057	0.000	0.000		0.023		74	61
24	0.151	29	0.044	0.043	0.028	0.041		-0.023		69	52
25	0.713	0	0.000	0.070	0.192	0.267		0.014		64	41
26	0.753	0	0.000	0.081	0.206	0.287		0.077		70	47
27	0.389	0	0.000	0.049	0.101	0.145		-0.030		73	60
28	0.151	0	0.000	0.044	0.042	0.061		-0.043		75	65
29	0.084	0	0.000	0.026	0.021	0.030		-0.023		75	69
30	0.078	0	0.000	0.012	0.018	0.026		-0.007		75	69
31	0.000	0	0.000	0.000	0.000	0.000		0.000		74	70
SUM	9.772	-	3.193	1.624	1.722	2.433	N.A.	0.350	N.A.	-	-
AVG	0.315	33	0.103	0.052	0.056	0.078	N.A.	0.011	N.A.	72	59
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SOLAR/2014-79/03

SITE: BLAKEDALE PROF. CENTER GREENWOOD,S.C.
REPORT PERIOD: MARCH,1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	992		54	56			
2	1882		60	71			
3	409		60	64			
4	246		65	68			
5	1759		66	73			
6	1771		55	61			
7	1823		56	68			
8	1540		55	61			
9	1900		54	*			
10	1082		56	64			
11	2257		48	54			
12	2335		55	68			
13	1785		60	*			
14	1310		60	64			
15	2173		54	67			
16	1788		48	56			
17	2064		55	70			
18	2009		64	77			
19	1873		68	80			
20	1696		72	85			
21	968		66	72			
22	660		63	68			
23	178		61	63			
24	602		52	52			
25	994		41	47			
26	2191		47	57			
27	1638		60	73			
28	2018		65	76			
29	1607		69	78			
30	1769		69	79			
31	1266		70	77			
SUM	46586	N.A.	-	-	-	-	-
AVG	1503	N.A.	59	67	N.A.	N.A.	N.A.
NBS ID	Q001		N113			N115	N114

NOT APPLICABLE

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